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Editorial

Modal shift, emission reductions and behavioral change: Transport policies and innovations to tackle climate change

Transport is one of the main contributors to climate change, requiring a shift in the current trends and mobility habits (Chapman, 2007). Business as usual scenarios are no longer acceptable, while disruptive future scenarios should be encouraged to tackle the ever-growing transport challenges (Hickman & Banister, 2014). Policy-making is fundamental to reverse unsustainable trends, fostering modal shift, emission reductions and behavioral change.

Modal shift is needed to move people (and freight) from polluting, often private, vehicles to sustainable transport modes, in accordance with the “shift strategies” of the so-called ASI approach, i.e. avoid (unnecessary trips), shift (trips from unsustainable to sustainable modes), and improve (the environmental performance of transport through technological improvements) (Bakker, Zuidgeest, De Coninck, & Huizenga, 2014). In relation to this, emission reductions can be fostered by acting on the three ASI legs at the same time, reducing the total transport energy required (Inturri et al., 2018). Besides, behavior change is an important aspect policy-makers should focus on to boost success probability of the strategies adopted, leading to modal shift and emission reductions (Gatta, Marcucci, & Le Pira, 2017). This applies both to passenger and freight transport. The latter is more complex since it involves more stakeholders, belonging to the public and private domain, often characterized by contrasting interests (Gatta & Marcucci, 2014). In this context, an effective approach should be focused on predictions (Marcucci & Gatta, 2016), acceptability (Le Pira et al., 2017a), and cooperation (Marcucci, Gatta, Marciani, & Cossu, 2017).

The scope of this special issue is to promote the diffusion of new knowledge and insights in the field of transport policies and innovations aimed at tackling climate change, focusing on modal shift, emission reductions and behavioral change. Methodological contributions, as well as relevant case studies, provide an improved understanding of policy assessment tools and promising transport innovations capable of influencing policy-makers’ decisions and modifying agents' behaviors.

The special issue originates from a NECTAR (Network on European Communications and Transport Activities Research) Cluster 2 meeting, focusing on policy and environmental issues, and, in particular, and represents an output of the 14th NECTAR International Conference held in Madrid (http://eventos.ucm.es/6146/detail/14th-nectar-international-conference_-transport-in-a-networked-society.html) from 31 May until 2 June 2017. Contributions were welcomed both from papers presented at the conference as well as from other sources discussing relevant advances in the field of sustainable transport policies and innovations.

Nine papers constitute the special issue, showing various perspectives from different parts of the world, i.e.: Italy (Gatta et al., 2019a; Inturri et al., 2019), Spain (Rahmani & Loureiro, 2019), France (Souche-Le Corvec, Mercier, Ovtracht, & Chevallier, 2019), the Netherlands (Wiercx, van Kalmthout, & Wiegmans, 2019), Sweden (Langbroek et al., 2019), United Kingdom (Percoco, 2019), South Korea (Kang & Lee, 2019) and Japan (Tanaka & Okada, 2019).

The topics addressed are: (1) transport policies aimed at limiting private cars' use and promoting sustainable modes of transport (Souche-Le Corvec et al., 2019); (2) methods and models to quantify the impact of transport on the environment (Percoco, 2019; Tanaka & Okada, 2019; Wiercx et al., 2019); (3) new technologies to limit the impact of transport on the environment, in particular electric mobility (Langbroek et al., 2019; Kang & Lee, 2019; Rahmani & Loureiro, 2019) and ICT-enabled new shared mobility services (Inturri et al., 2019); (4) market-based measures to modify the present trends and pro-actively respond to sustainability challenges (Tanaka & Okada, 2019); (5) policy-making processes based on stakeholder involvement methodologies and participatory decision-support methods and models (Gatta et al., 2019a).

The papers are introduced according to the three interconnected elements motivating the special issue, i.e.: (1) modal shift, (2) emission reductions and (3) behavioral change. Each paper can indeed address more elements at the same time, however we focus on the main one.

1. Modal shift

Wiercx et al. (2019) propose a model to encourage a shift from unsustainable freight transport by road to inland waterway transport (IWW). The model aims at analyzing the optimal configuration and operation of reach stackers and terminal yard cranes given certain throughput levels at Inland Waterway Terminals (IWTs). Under this respect, the Authors argue that one of the ways to increase the performance, sustainability and quality of IWW transport is to focus on the configuration of the IWT. Model results show a growing throughput results in scale economies for IWTs. This could increase the modal shift from road to barge thus increasing transport sustainability. Results can also contribute to managerial decisions to be taken by IWW terminal operators and provide relevant insights into the consequences of certain sustainability policies of local authorities on terminal operations.

Souche-Le Corvec et al. (2019) stress the importance of a comprehensive analysis based on heterogeneous indicators to evaluate policies that could foster modal shift, focusing on the case of Lyon. In particular, road pricing is considered as a good solution able to both reduce traffic congestion and produce revenues for public transport. The Authors use the so called MOSART modelling platform to test several pricing solutions based on possible future scenarios (2030) with respect to multiple urban indicators (environment, accessibility, social inequality, public

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transport performance, public funding requirements). Results suggest that it is possible to implement an urban toll capable of generating new revenues without increasing inequality and, if associated to the transformation of the fleet of vehicles into electric vehicles (EV), it would also reduce CO_2 emissions. The Authors conclude from their analysis that policy packages based on urban road toll and electric vehicles could become the "winning ticket" for Lyon in the future.

Inturri et al. (2019) explore the potential of new mobility services able to induce a modal shift from individual to shared transport. The Authors focus on ICT-enabled Demand Responsive Shared Transport (DRST) services, which are particularly suitable to bridge the gap between shared low-quality public transport and unsustainable individual private transport. They propose an agent-based model fed with GIS data to explore different system configurations of a specific type of DRST service, i.e. flexible transit, and to estimate the transport demand and supply variables that make the service feasible and convenient. Under this respect, they argue that the optimal design of a DRST service requires a trade-off among efficiency (from the operators' point of view), service quality (from the users' point of view) and sustainability (from the community's point of view). Results illustrate an optimal range of operating vehicles that minimizes a total unit cost indicator, accounting both for passenger travel time and vehicle operating cost. This allows deriving useful suggestions for the correct planning, management and optimization of DRST services.

2. Emission reductions

Kang and Lee (2019) focus on the potential emission reductions obtained by improving vehicle technologies. In particular, the paper examines the economic feasibility of replacing the current fleet of fossil fuel taxis in Seoul with EV taxis, by gradually phasing the former out based on their operational lifetime. The Authors perform a Cost Benefit Analysis, including costs of purchasing vehicles, constructing and maintaining charging infrastructure, benefits linked to the avoided environmental costs due to reduced air pollutants and greenhouse gas emissions. Traffic assignment is incorporated in the calculation process for a better estimation of the avoided costs. The resulting benefit-cost ratio testifies to the economic viability of the deployment of EV taxis and is encouraging for pushing the transition to electric vehicles forward.

Gatta et al. (2019a) investigate the potential of innovative solutions aimed at shifting freight delivery out of the peak traffic, i.e. off hour deliveries (OHD). This could lead to a more efficient distribution of freight in cities, reducing the impact of freight transport and fostering emission reductions. The Authors focus on stakeholder acceptability of OHD solutions in Rome, by investigating stakeholders' preferences for different OHD configurations using both a qualitative approach, based on in-depth interviews, and a quantitative analysis, resting on an interactive multi-actor multi-criteria analysis. Results are encouraging, since they suggest that stakeholders are likely to accept OHD, and prefer a solution where OHD are jointly implemented with one or more urban consolidation centers. This can pave the way for further technical/economic evaluations of OHD within the transport planning processes in the city of Rome.

Tanaka and Okada (2019) analyze the potential effects of market-based measures for international shipping on emission reduction. These policies aim at providing shipping companies with incentives to reduce CO2 emissions and change long-term behavior for ships, especially investment in capacity and fuel efficiency. The Authors propose a theoretical model to analyze the investment behavior of a shipping company, improvement of fuel efficiency, and CO2 emissions from ship operations by introducing a tax on them. Useful results include optimal conditions, the relationships between fuel price with emission tax and investment behavior, the rebound effect of improving fuel efficiency via the tax, and allow suggesting a policy mix consisting of tax and a direct subsidy for an international shipping company.

3. Behavioral change

Langbroek et al. (2019) investigate the determinants to foster behavior change towards EV. The Authors use the Protection Motivation Theory and the Transtheoretical Model of Change to analyze the influence of EV rental scheme on the process towards EV adoption. The case study is Gotland (Sweden), where there is a network of charging infrastructure and EV rental during several summer seasons. Interesting results of this study are that people renting an EV are, on average, closer to their adoption than people renting a conventional vehicle. Besides, they are associated with more positive attitudes towards EV, have more knowledge about them and would feel more secure driving them. Lastly, driving patterns of EV do not seem to indicate serious limitations regarding driving distance, parking time and the destinations that have been visited, as compared to the driving patterns of conventional rental cars. All these results are encouraging and pave the way for future research aimed at fostering behavioral change towards EV.

Percoco (2019) focuses on a niche, though very important, topic for transport research, i.e. behavioral response to terrorist attacks. Literature typically focused on the impact of attacks in terms of their death toll, disruption, and economic impact with the aim to reduce the burden of such events in terms of direct effects. Less attention has been paid to secondary effects, mainly driven by behavioral responses of users of public transit systems perceiving it as riskier if compared to private transport. The Author specifically focuses on the environmental impact induced by behavioral responses to terrorist attacks occurred in London on July 7, 2005. By relying on the "dread hypothesis" and on the evidence of an increase in private transport subsequent to the attacks, the Author estimated econometric models of pollution concentration. Results show a substantial environmental impact in terms of PM10 and NO2, possibly driven by an increase in the perception of higher safety of private transport with respect to public transit, and suggest policy-makers to increase their attention with respect to behavioral consequences of any policy.

Rahmani and Loureiro (2019) analyze preferences for hybrid EV (HEV) with the aim to induce a behavioral change. The Authors used stated preference methods (contingent valuation and a discrete choice experiment) in a survey conducted in a representative sample of Spanish drivers, showing an average positive willingness to pay to buy HEV, although insufficient to actually cover their extra cost. The Authors conjecture that this may be motivated by different reasons, including the low level of information related to this technology and additional false believes about the autonomy of these vehicles. Furthermore, drivers who declare a willingness to buy HEVs do not always do so for environmental reasons, but rather for reputational issues related to their self-image. Based on the results of their analysis, the Authors suggest informative campaigns and additional economic incentives in order to increase the market share for HEV vehicles in the Spanish market.

4. Conclusion

The papers in this special issue raise interesting points that can stimulate future research. Forecasting the future is always challenging and risky. However, sound analyses can guide policy-makers towards better-informed and well-thought-out decisions.

First, *ex-ante* evaluations based on the use of sound methods/tools (e.g. economic, mathematical, simulation-based, psychological) are fundamental to estimate, before implementation, the likely policy impacts on sustainability and, thus, on the environment (e.g. Evangelinos, Tscharaktschiew, Marcucci, & Gatta, 2018; Gatta et al., 2019b,b; Valeri et al., 2016). By the same token, behavioral analyses and participatory practices are important to take into account different stakeholder perspectives, and elicit their preferences and opinions, so to tailor policies and foster behavioral change towards sustainable mobility (e.g. Le Pira et al., 2017b; Marcucci, Gatta, & Le Pira, 2018; Marcucci & Gatta,

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2017). Future research should try to reduce the gap between technical analyses and stakeholder-driven evaluations, so to find solutions that are technically consistent while stimulating stakeholder consensus.

Second, monitoring and *ex-post* evaluations are also needed to assess the actual impact of policies, providing feedback to stakeholders and policy-makers for further stages, increasing the credibility of evaluation methods/models and laying the basis for fine-tuning the models (Cascetta, Carteni, Pagliara, & Montanino, 2015). Finding the appropriate indicators to measure and monitor policy impact, e.g. on the environment, is therefore fundamental for future transport research.

Finally, as also testified by the fast innovations introduced by new technologies (e.g. automation, shared mobility), a substantial change in current mobility habits is feasible in the near future. Climate change challenges can be no longer postponed, and should be the priority for policy-makers. Future research should help dealing with this urgency, by focusing on disruptive long-term future transport scenarios and effective policies able to make scenarios reality.

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